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(54) A vehicle suspension spring assembly

(57) A vehicle suspension spring assembly is composed of a soft spring in the form of a pack 10 of thin spring leaves, a first stiff leaf spring 12 in the form of a single thick leaf, and a second stiff leaf spring 21 stiffer and shorter than th first. The configuration of the spring elements is such that in the unloaded state end gaps 14 are formed between the pack 10 and the first single leaf spring 12 and further gaps 22 are formed between the first and the second single leaf springs 12 and 21. Upon applying a load, the gaps 14 will be closed at approximately 50% load, and the gaps 22 at approximately 100% load. By this arrangement the spring characteristic of the spring ass mbly will be progr ssive up to approximately 50% and thereafter rectilinear at a steep angle.

FIG.1

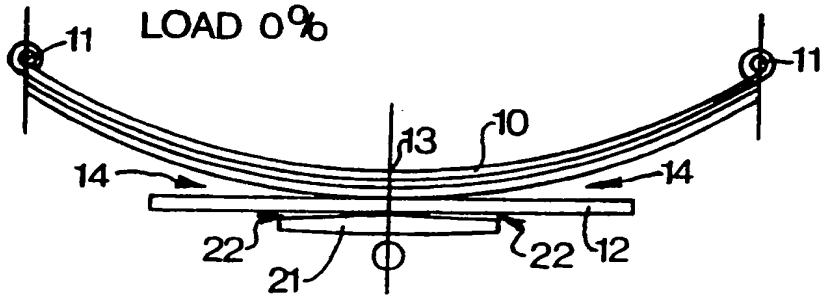

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FIG.1

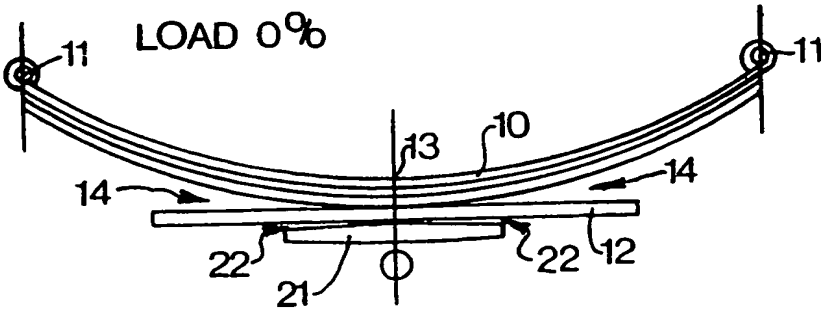


FIG.2

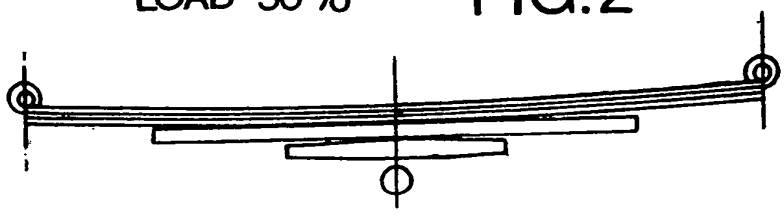


FIG.3.

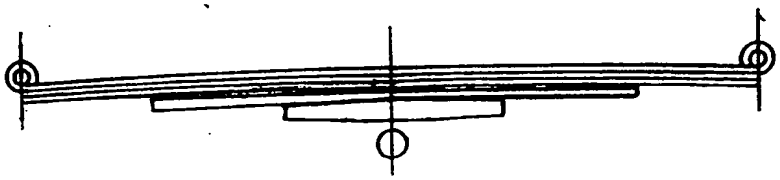
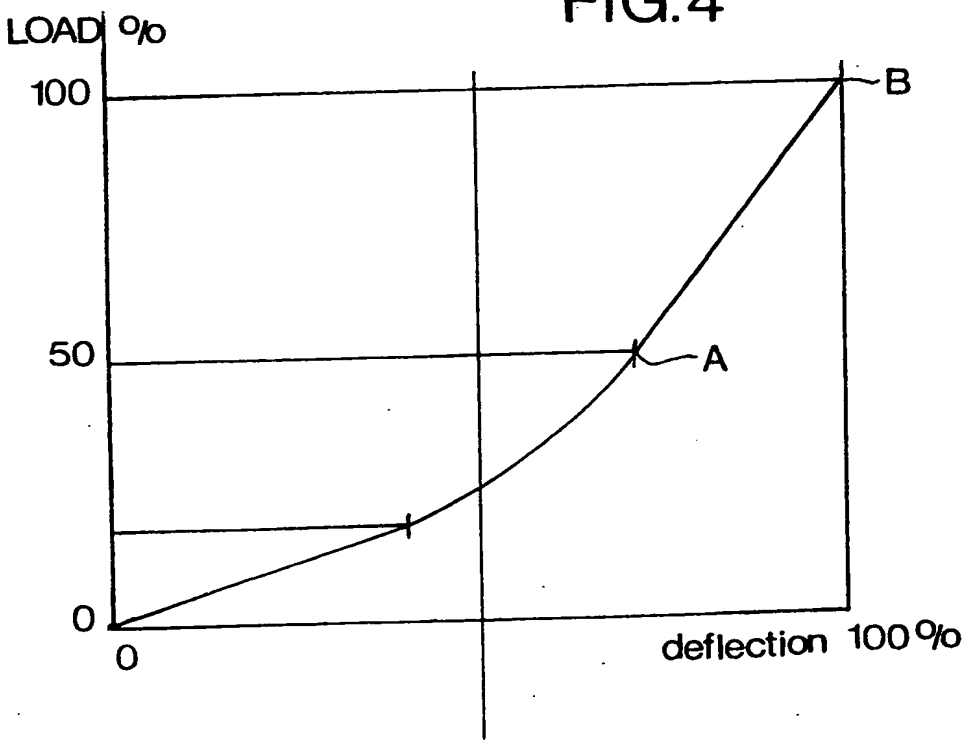


FIG.4



SPECIFICATION

A v hicle susp nsi n spring ass mbly

This invention relates to progressive leaf springs.

In order to obtain a satisfactory suspension of a vehicle—by way of example a lorry or a railway car—under all conditions of loading, it is well-known to employ the principle of progressive spring suspension, which means that the springs are manufactured in such a manner that their resistance increases with increasing load. This is usually obtained by means of an auxiliary spring which is mounted above or below the ordinary or main spring. When the loading has reached a certain limit, the auxiliary spring goes into action in order to support and strengthen the main spring.

From the U.K. patent specification No. 1,245,636 a progressive leaf spring is known in the form of a vehicle suspension spring assembly comprising a soft spring in the form of a pack of relatively thing spring leaves and a stiff spring in the form of a single thick spring leaf. The arrangement is such that the progressiveness of the spring characteristic extends over the whole of the loading range from zero to full load.

It has been found that from an economical point of view this known type of spring is not ideal, because it is expensive and unnecessary to extend the progresiveness up to the full load. It has also been found that considerations of height variations in respect of automatic couplings, and safety against derailment also speak for limiting the progressiveness to about the lower half of the loading range, the upper half having a linear characteristic.

It is the object of the invention to provide a vehicle suspension spring assembly fulfilling these conditions.

According to the invention, a vehicle suspension spring assembly comprises, in succession from top to bottom, or vice versa, a soft spring in the form of a pack of relatively thin spring leaves, a first stiff spring in the form of a single thick spring leaf, and a second stiff spring likewise in the form of a single thick spring leaf, said second stiff spring being shorter than said first stiff spring and having a considerably higher stiffness than the latter, the shape of said springs being such that in the n n-loaded state of the spring assembly first gaps ar formed between the end of said first stiff spring and the bottom face of said soft spring, and second gaps are formed between the ends of said second stiff spring and the bott m face of said first stiff spring, the dimensioning being such that upon increasing load being appli d to the spring assembly, said first gaps are closed considerably before reaching the full load for which the spring assembly is constructed, preferably at approximately 50% load, while said second gaps are closed only at approximately full load or even, though l ss pref rred, at a still higher load.

Th inv ntion will be furth r xplained with reference to the accompanying drawing, in which

Figure 1 shows a spring assembly in accordance with a preferred embodiment of the invention, the spring assembly being shown in non-loaded condition,

Figure 2 shows the same spring assembly in partly loaded condition, the load corresponding to 50% of the full load, for which the spring assembly is constructed,

Figure 3 shows the same spring assembly in fully loaded condition, and

Figure 4 is a diagram illustrating the spring characteristic of the spring assembly shown in Figs. 1–3.

The progressive spring assembly shown in Fig. 1 comprises a soft upper spring 10, which consists of a number of comparatively thin leaves and may be provided at its ends with spring eyes 11 in the usual way, by way of example for the connection to a chassis frame, a first stiff spring 12 consisting of a single thick leaf, and a second stiff spring 21 likewise consisting of a single thick leaf. All the springs are firmly clamped together intermediate their ends at 13.

The shape of the springs is such that in th non-loaded state of the spring assembly first gaps 14 are formed between the ends of the first stiff spring 12 and the bottom face of the soft spring 10, and second gaps 22 are formed between the ends of the second stiff spring 21 and the bottom face of the first stiff spring 12.

When the spring assembly is loaded, the gaps 14 will be deminished gradually, the load transfer point between the upper soft spring 10 and the first stiff spring 12 being progressively displaced towards the spring end. The dimensioning is such that at approximately 50% of full load the upper spring 10 rests against the full length of the first stiff spring 12 so that the gaps 14 are closed, as illustrated in Fig. 2.

Upon further increase of the load, the gaps 22 between the first stiff spring 12 and th second stiff spring 21 are gradually closed, s as to be fully closed at 100% load, as illustrated in Fig. 3.

The spring characteristic of the spring assembly illustrated is shown in Fig. 4, wher deflection of the spring assembly is plotted against the load acting on the assembly. Point A in the graph illustrates the condition depicted in Fig. 2, where th gaps 14 have just been closed. Up to this point the spring characteristic is progressive for the reasons explained above. On furth r increase of the load, the spring characteristic, owing to the higher stiffness of the second stiff spring 21, is rectilinear at a st ep angle. Point B of the

graph corresponds to full load.

In order to obtain the best possible economy of materials, th second stiff spring 21 is constructed in such a manner that its cross section decreases from the clamping point 13 towards the free ends, the upper side of this spring being given such a curved shape in n n-loaded condition that the first stiff spring will be subjected over the larger part of its length to circular curvature when deflected to full load. Through this it is possible to obtain that at full load the greater part of all the springs of the assembly are subjected to approximately uniform stresses corresponding to the maximum permissible stress.

In an example, the thickness of the various spring elements may be selected as follows:

Each leaf of the soft spring 10: 16 mm.

First stiff spring 12: 27 mm.

Second stiff spring 21: 42 mm.

CLAIMS

1. A vehicle suspension spring assembly comprising, in succession from top to bottom, r vice versa, a soft spring in the form of a pack of relatively thin spring leaves, a first stiff spring in the form of a single thick spring l af, and a second stiff spring likewise in the form of a single thick spring leaf, said second stiff spring being shorter than said first stiff spring and having a considerably higher stiffness than the latter, the shape of said springs b ing such that in the non-loaded state of the spring assembly first gaps are formed between the ends of said first stiff spring and th bottom face of said soft spring, and second gaps are formed between the ends of said second stiff spring and the bottom face of said first stiff spring, the dimensioning being such that upon increasing load being applied to the spring assembly, said first gaps are closed considerably before reaching the full load for which the spring assembly is constructed, preferably at approximately 50% load, while said second gaps are closed only at approximately full load or even, though less preferred, at a still higher load.

2. A vehicle suspension spring assembly as in claim 1, in which said second stiff spring has a thickness decreasing from its middle towards its ends.

3. A vehicle suspension spring assembly as in claim 2, in which said second stiff spring has a convex curvature on its upper side.

4. A v hicle suspension spring assembly as in any of the beforegoing claims, in which said first stiff spring has a constant thickness in the whole of its l ngth.

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